THE DESIGN OF COASTAL SEA BARRIER AND WASTE MANAGEMENT FOR BARANGAY TALIPTIP, BULAKAN, BULACAN

A Quantitative Research

Presented To the Faculty of

Civil Engineering Division

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science in Civil Engineering

Major in Construction Engineering and Management

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RECOMMENDATION

This is to certify that this research entitled "THE DESIGN OF COASTAL SEA BARRIER AND WASTE MANAGEMENT FOR BARANGAY TALIPTIP, BULAKAN, BULACAN" prepared and submitted by Ritz Agnir, Joshua Asistente, Paul Wilfred Duran, and Melvin Rosas had been examined and PASSED the PRE-ORAL DEFENSE.

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CERTIFICATE OF ORIGINALITY

The researchers confirm that this research is their original work and has not been previously submitted or published. All sources and contributions have been properly cited, and the findings, analysis, and conclusions are the result of independent research.

Furthermore, the researchers declare that this study is free from plagiarism and has been conducted with honesty and integrity, although they received assistance and guidance from others. The researchers take full responsibility for the accuracy and authenticity of the content presented in this research.

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CHAPTER I

The Problem and Its Background

This chapter exhibits the basis of the study which includes the overall background and significance of the topic, theoretical and conceptual framework, statement of the problem, hypothesis, scope and limitations, and the terms related to the study. In addition, this chapter aims to emphasize the importance of the chosen topic for this study.

Introduction

Over the past few years, flooding has been a recurring challenge in the Philippines, specifically in Bulacan due to frequent occurrence of strong typhoons, sea -level rise due to some parts being near the Manila Bay, and continuous land subsidence caused by non-stop ground water extraction. As time passes by, the occurrence of different types of natural disasters tend to increase and become more severe, creating a significant impact not only on the infrastructures, but also to the environment and the community. Wena Cos from the ABS-CBN News reports that the streets in Barangay Taliptip, Bulakan, Bulacan, submerges in sea water at least twice a month, estimately for 3 to 7 days causing it to be flooded even if there is no rain at all. Also, they've mentioned that the barangay slowly sinks due to the long-term effects of global warming. Although fishery is the primary livelihood of the families in the aforementioned barangay, still, the community has been having a hard time

coping up with the temporary solution done by the government which is to constantly dump concrete and level onto the floors of their homes.

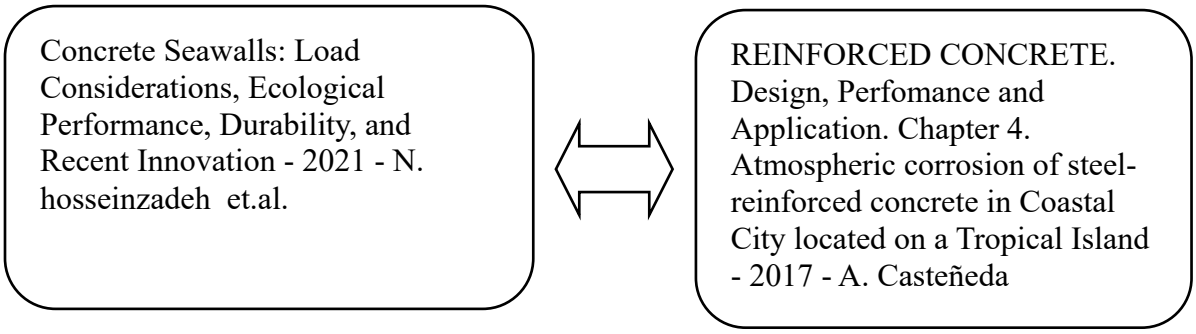
Background of the Study

Coastal sea barriers serve as a protection for the coastal areas from different natural calamities such as tides, tsunamis, storm surges, and erosion. It tends to absorb and reflect the wave energy, functioning like a physical barrier between the land and sea. These barriers consist of several types of sediment which depends on where it will be located. Seawall barrier is a firm type of structure, typically made out of stone or concrete, built parallel to the shoreline. On the other hand, gabions are constructed to absorb wave energy using mesh cages which contain rocks stabilizing the affected areas. As for dikes or levees, these are large embankments holding back water from seas, lakes and rivers to control water levels and prevent further coastal and river flooding. Since flooding is considered to be a repetitive problem in Barangay Taliptip, designing a coastal sea barrier and implementing an effective waste management in the aforementioned area is crucial in terms of mitigating flood risks, avoiding the disruption of daily activities, as well as further damaging of infrastructures.

San Miguel Corporation (SMC, 2021) collaborated with the government to commence a coastal cleanup in Barangay Taliptip since the New Manila International Airport will be developed in this barangay. Hence, it is urgent for them to hire workers under the Tulong Panghanapbuhay sa Ating Disadvantaged/Displaces Workers (TUPAD), headed by the Public Employment Service Office (PESO) of the Provincial

Government of Bulacan, Office of Senator Joel Villanueva, and the Department of Labor and Employment (DOLE). Aside from prioritizing the coastal areas of Bulacan, this project also aims to help the less-fortunate people residing in Barangay Taliptip. Organizing these regular coastal cleanups would be of big help towards the improvement project for the other areas in Bulacan, including Marilao, Meycauayan, and Obando river system (MMORS), which is a major component of the flood mitigation initiative not only in Barangay Taliptip but also on the majority of the areas in Bulacan.

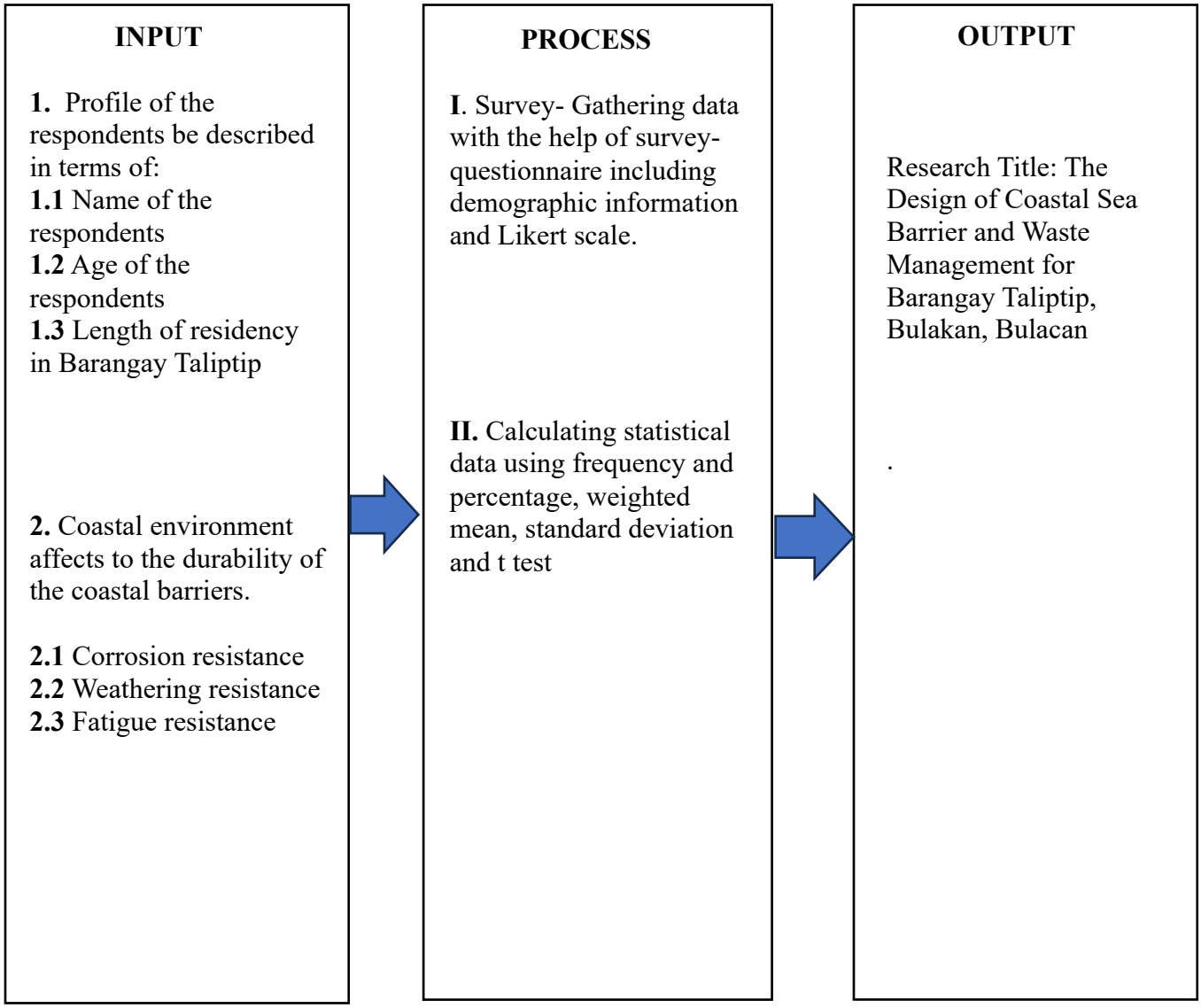
Theoretical Framework

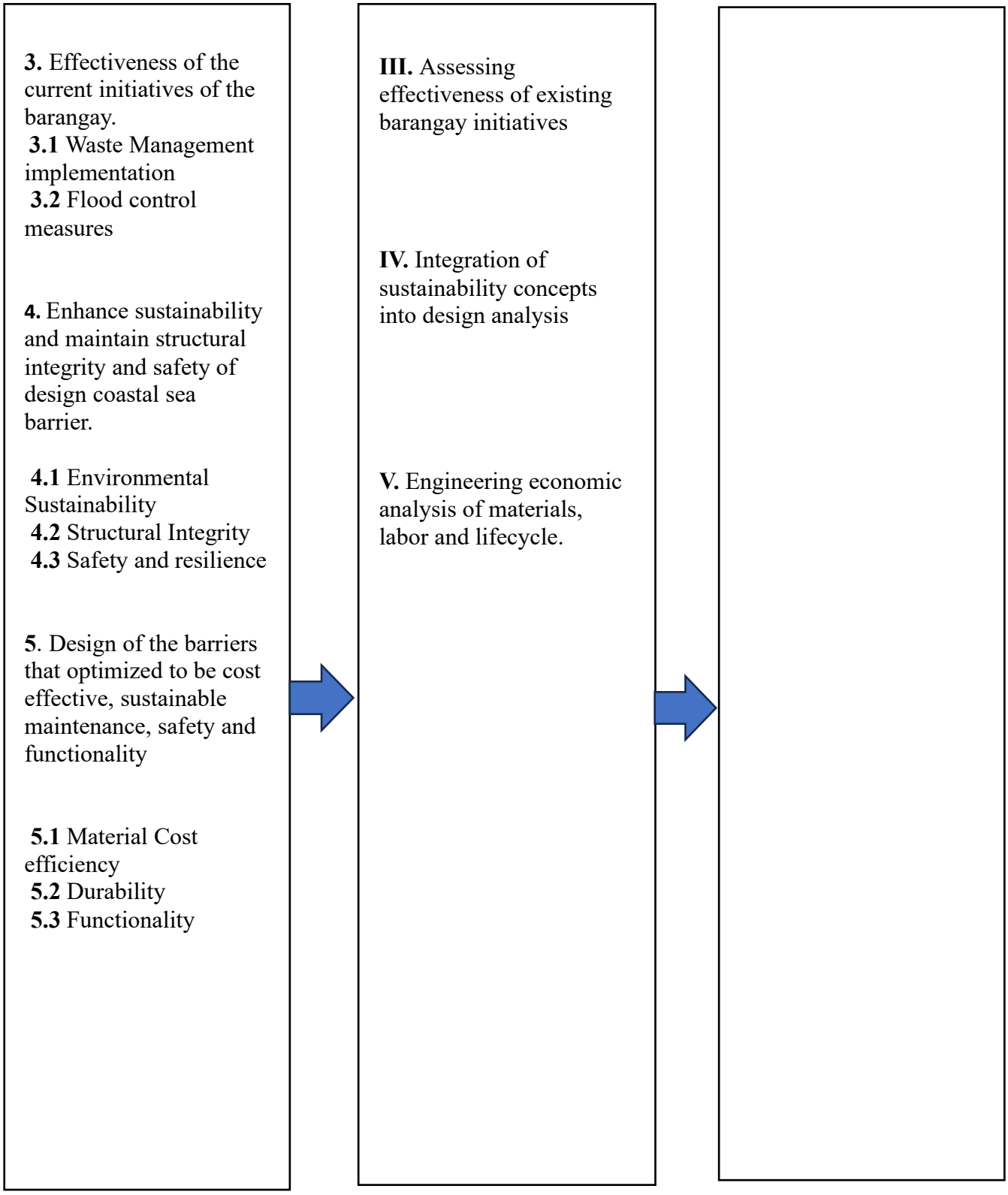

Concrete Seawalls: Load Considerations, Ecological Performance, Durability, and Recent Innovation - 2021 - N. hosseinzadeh et.al.
REINFORCED CONCRETE. Design, Perfomance and Application. Chapter 4. Atmospheric corrosion of steel-reinforced concrete in Coastal City located on a Tropical Island - 2017 - A. Casteñeda

The researchers interrelated the mentioned theories above due to their significant relevance to the study. The first theory discusses about the concrete sea wall structure in terms of loading consideration, design, efficacy, ecological effects and durability. As for the second theory, it contains the structural aspects such as corrosion resistance, environmental features, structural integrity and the efficiency of materials. These two theories are linked since they both discuss the design that will be done in this study.

Conceptual Framework

The paradigm of the study's conceptual framework using the Input-Process-Output model as an evaluation framework is shown below. The input represents the ideas that the researches wished to examine and integrate. The process specifies the procedures that the researchers used to generate an output from the input. The output illustrates the specific objective of the study, which is to design an effective sea barrier and establish a waste management system for Barangay Taliptip, Bulacan.


INPUT
1. Profile of the respondents be described in terms of:
1.1 Name of the respondents
1.2 Age of the respondents
1.3 Length of residency in Barangay Taliptip
2. Coastal environment affects to the durability of the coastal barriers.
2.1 Corrosion resistance
2.2 Weathering resistance
2.3 Fatigue resistance
PROCESS
I. Survey- Gathering data with the help of survey-questionnaire including demographic information and Likert scale.
II. Calculating statistical data using frequency and percentage, weighted mean, standard deviation and t test
OUTPUT
Research Title: The Design of Coastal Sea Barrier and Waste Management for Barangay Taliptip, Bulakan, Bulacan
.


3. Effectiveness of the current initiatives of the barangay.
3.1 Waste Management implementation
3.2 Flood control measures
4. Enhance sustainability and maintain structural integrity and safety of design coastal sea barrier.
4.1 Environmental Sustainability
4.2 Structural Integrity
4.3 Safety and resilience
5. Design of the barriers that optimized to be cost effective, sustainable maintenance, safety and functionality
5.1 Material Cost efficiency
5.2 Durability
5.3 Functionality
III. Assessing effectiveness of existing barangay initiatives
IV. Integration of sustainability concepts into design analysis
V. Engineering economic analysis of materials, labor and lifecycle.

Statement of the Problem

In this study, the researchers aim to determine data to be considered in the "Design of Coastal Sea Barrier and Waste Management in Barangay Taliptip,, Bulacan, this research wants to assess the current situation in Barangay Taliptip, identify gaps in existing plans, and suggest practical solutions that consider environmental, social and economic factors.

This study seeks to answer the following questions:

1. **What is the demographic profile of respondents in terms of:**

1.1 Age
1.2 Gender
1.3 Length of residency in Barangay Taliptip

2. **How can the coastal environment affect the durability of the coastal barriers?**

2.1 Corrosion resistance
2.2 Weathering resistance
2.3 Fatigue resistance

3**. How can the design of the barriers be integrated into coastal areas to reduce flooding and solid waste management?**

3.1 Concrete barrier design
3.2 Flood water depth
3.3 Waste quantity

4. **How can the design of the barriers enhance sustainability and maintain structural integrity and safety?**

4.1 Environmental Sustainability
4.2 Structural Integrity
4.3 Safety and resilience

5. **How can the design of the barriers be optimized to be cost effective, sustainable maintenance, safety and functionality?**

5.1 Material Cost efficiency
5.2 Durability
5.3 Functionality

Objectives of the Study

This study aims to design an effective coastal sea barrier and waste management for Barangay Taliptip, Bulakan, Bulacan. The specific objectives of this study are:

1. To investigate how the coastal environment affects the durability of the coastal barriers.

2. To examine how the design of the barriers can be integrated into coastal areas to reduce flooding and solid waste management.

3. To assess how the design of the barriers can enhance barrier sustainability and maintain structural integrity and safety.

4. To determine how the design of the barriers can be optimized to be cost-effective, sustainable maintenance, safety and functionality.

Hypothesis

- Null Hypothesis (H0): There is no significant difference in the Design of Coastal Sea Barrier and Waste Management for Barangay Taliptip, Bulacan.
- Alternative Hypothesis (H1): There is significant difference in the Design of Coastal Sea Barrier and Waste Management for Barangay Taliptip, Bulacan.

Significance of the Study

Designing and constructing coastal sea barriers in Barangay Taliptip are significant towards the following:

To Residents of Barangay Taliptip, Bulacan

Creating such structure will be beneficial to the majority of the population of Barangay Taliptip since it will serve as a protection for their homes and properties from land erosion and landslides. Since their area is prone to sudden flooding even without rain pour, if coastal sea barriers would be properly designed and built, it would be able to withstand additional forces, hence, providing protection against extreme water levels.

To Engineering Students

Sea barriers can be considered significant towards the engineering students since this will serve as a challenge for them to come with the design and construction of sea barriers using different types and materials, depending on what they think would be the most durable and efficient. They can experiment with the selection of materials, integration of engineering principles learned, and consideration of the overall impacts of this research towards the community of Barangay Taliptip.

To the Manufacturing Industry

Since this research involves usage of different materials, it would be beneficial to the manufacturing industry because they would be aware of what type of materials suits the coastal sea barriers. In addition, after finding out the overall function and goals of the research, they would be informed about the budget, durability, material compatibility, long -term maintenance, and other factors needed to be considered as well.

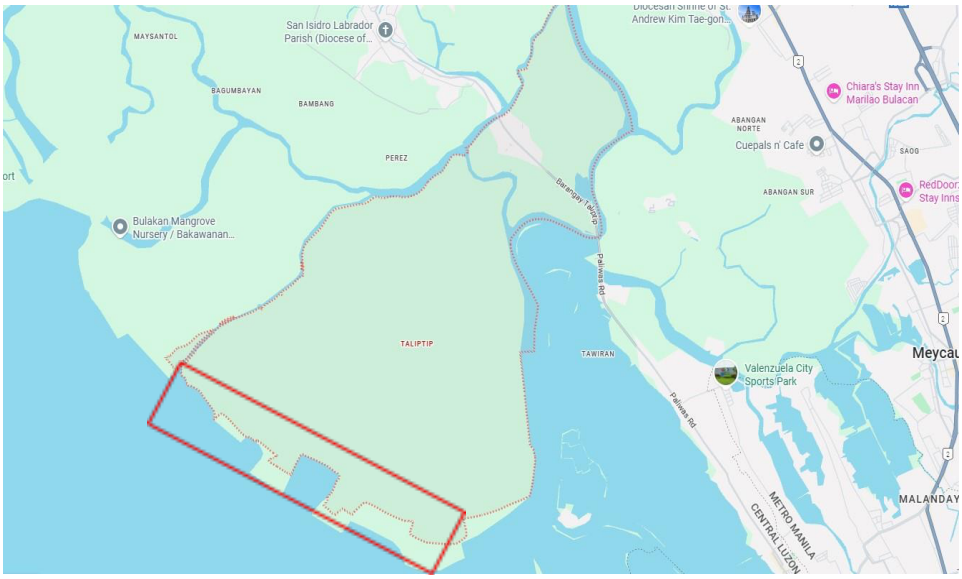
To the Future Researchers

The existence of coastal sea barriers as a topic for research would be beneficial to the future researchers since this may serve as their foundational baseline for an improved version of new studies. They may use this as a basis in identifying the knowledge gaps for the present research. Also, the topic may

serve as a benchmark for future studies. They may twitch several factors of the existing research in order to create a more innovative and advanced approach.

Scope and Limitation of the Study

This study discusses the Design of Coastal Sea Barrier and Waste Management for Barangay Taliptip, Bulacan mitigating flooding in the said area caused by progressive rising sea level. Additionally, the design of the proposed coastal sea barrier may be useful in terms of managing solid wastes that can mix up with river streams and run off this scope encompasses conceptualizing the layout of the barrier, its materials, and the overall structure, with a focus on mitigating flooding and manage solid waste that is already mixed up with the water forms. Implementation and long-term maintenance are not part of the study. Neither does it include budget analysis and financial feasibility studies. The study's scope is limited only on a specific area at Barangay Taliptip, Bulacan, hence, results may vary once this study would be applied and conducted to other places in the Philippines.



Definition of Terms

- **COASTAL BARRIERS** – naturally formed, low-lying strip of sand or type of sediment built along the mainland to protect the coast from high tides, storm surges, and tsunamis. (Maine Department of Agriculture, Conservation & Forestry, 2025)
- **SEAWALLS** – type of defense structure using heavy materials to prevent land erosion and flooding due to unexpected storm waves and surges. (Climate ADAPT, 2023)
- **FLOOD MITIGATION** – either structural or non-structural form mitigating harm by reconstructing landscapes which includes building floodwalls/seawalls, flood gates, and evacuation routes. (NCSL, 2019)

- **MATERIAL COST EFFICIENCY** – refers to a material's capacity to provide the required performance or quality while lowering related expenses. It places a strong emphasis on choosing materials that offer the best performance and cost balance. (Smith, 2020)
- **DURABILITY** – ability of a material or product to continue performing its intended function for an extended amount of time in spite of exposure to environmental factors, wear, or stress (Jones and Lee, 2019)
- **FUNCTIONALITY** – extent to which a material or product fulfills its intended function or task in a reliable and efficient manner under anticipated circumstances (Anderson, 2021)
- **PETROGRAPHY** – branch of geology that studies rocks in detail, particularly their composition, texture, and structure, mainly through microscopic examination of thin sections using a polarizing (petrographic) microscope.
- **NATIONAL STRUCTURAL CODE OF THE PHILIPPINES** – primary code of practice used by engineers, architects, and builders in the Philippines for the design and construction of buildings and other structures.
- **WAVE OVERTOPPING** – happens when waves run up and flow over the top of a coastal structure (like a seawall, breakwater, or revetment).
- **MORPHOLOGICAL CHANGES** – refers to the alterations in the shape, form, or structure of a landform or coastline over time due to natural processes or human activities.

CHAPTER II

REVIEW OF RELATED LITERATURE

FOREIGN STUDIES:

Romei et al. (2021) studied about a particular technique in reducing sewer overflows and bathing water contamination by building a detention reservoir. Since climate change tend to affect rainfall regimes not only in Europe but all over the world, the authors of this study came up with a way to address problems caused by the existing ineffective urban sewerage systems. Instead of just improving the existing sewerage systems, they've designed a more innovative storm water detention tanks in order to mitigate impacts of combined sewer overflows. In Taliptip, Bulacan, the researchers will use a similar technique to control the waterflow but instead of detention tanks, they will be designing coastal sea barriers which would not only serve as protection from storm water and surges but also establish an effective waste management in the said area.

In relation to the proposed topic of the researchers, Perricone et al. (2024) worked on bioinspired coastal barriers. First, they chose coastal barriers to be their means to stabilize and protect coastlines without destroying biodiversity after picking out from numerous artificial infrastructures. According to them, choosing traditional infrastructures such as seawalls, jetties, breakwaters, and rock groynes tend to be unsustainable in the long run since they are bulky, monofunctional, unadaptable, and consist of hard engineering solutions. In addition, the aforementioned infrastructures

occupy vast space and absolve only coastal defense role, hence, biodiversity and protection of species proliferation are not within their scope. These researchers wanted to target not only protecting and stabilizing the coastlines but also promoting local biodiversity as well. Similar to the researchers' current idea, they aim to also control the wastes in Taliptip, Bulacan aside from controlling only the water level in the said area.

According to Deng, J., Pan, Z., Mai, G., Long, Y., Kuang, B., Zhu, J., Guo, Q., Liang, J., Huang, F., Qiao, S., Li, X., & Liu, F the combined use of seawater sea sand concrete (SSC) and fibre-reinforced polymer (FRP) bars shows promising potential for structural applications. This study examined the fatigue performance of carbon fibre-reinforced polymer (CFRP) bar-reinforced SSC beams, focusing on load levels and stirrup spacing as key parameters. Using four-point bending tests, the progression of fatigue crack width and deflection was analyzed. Findings showed that excessive stirrup spacing altered the static failure modes of CFRP-reinforced beams, reducing their mechanical performance; thus, a maximum stirrup spacing of 200 mm was recommended. The predominant fatigue failure mode observed was shear fatigue, with both crack width and deflection increasing with load cycles. Notably, at 80% of fatigue life, crack width nearly doubled, while fatigue deflection rose by 166–189% near failure. Load levels significantly influenced fatigue life, leading to the proposal of a fatigue limit ratio of 0.5. Furthermore, wider stirrup spacing accelerated the growth of cracks and deflection. Building on these results, the study refined the crack width equation to account for stirrup spacing, load levels, and fatigue cycle ratios, and

proposed a calculation model for fatigue deflection. Ultimately, the research improved the fatigue design framework by distinguishing between fatigue life related to load-bearing capacity and normal service.

According to Carlos Coelho, et al. (2021) Wave overtopping, often intensified by coastal erosion, poses direct risks to communities by causing flooding, damage, and economic loss. As a result, future investments in coastal defense structures are expected to rise, particularly in socially, environmentally, and economically valuable coastal areas. Given the high lifetime costs of these structures, it is essential to improve knowledge of their performance to achieve cost-effective and resilient solutions. To address this, the XD-Coast model was created for preliminary design, while the COAST model was developed for cost-benefit analysis. However, the initial XD-Coast version lacked the ability to predict overtopping. This study therefore integrates overtopping into both models to assess the balance between construction costs and the damages associated with overtopping and flooding hazards. Focus was placed on the design of rocky revetments, specifically slope and crown levels, and their effectiveness in reducing flood impacts. Using a real case from Ovar, Portugal, the study showed that overtopping and flooding data from the Portuguese Environment Agency (APA), when accurately reproduced through modeling, provide valuable insights into estimating impacts and establishing links between events and associated costs.

Kumar et al. (2025) conducted a study about sustainable corrosion inhibition through green inhibitors which combine inhibitors while developing extended corrosion defense systems that fight microbial corrosion. The research team started

their work to find plant extracts with eco-nanomaterials. The researchers aimed to reduce the environmental harm of standard environmentally friendly corrosion inhibitors which would replace traditional options because of their toxic impact on the environment.

Sawicki et al. (2021) studied the fatigue behavior of reinforced Ultra-High Performance Fiber Reinforced Cementitious composite (R-UHPFRC) beams. The experimental investigation focused on UHPFRC materials to be used for structures that are subjected to cyclic loading considering its fatigue resistance as a crucial requirement for bridges and barriers. The authors conducted fatigue tests to investigate crack growth by sensing stiffness degradation and modes of failure as a result of multiple loading cycles. The researchers aimed to determine the optimal composition of materials and methods of reinforcement that would increase the service life of reinforced concrete structures.

LOCAL STUDIES:

Sotto (2022) conducted a study regarding the flood control measures in Camarines Sur located in Bicol as a basis for community-based flood control interventions. Flooding is a type of hydrometeorological hazard that is inevitable which creates an impact towards the agriculture and economy of a certain area. This researched aim to determine and assess the flood control measures in the municipality of Nabua using a descriptive evaluative survey method. In relation to the researchers' objectives, they would also be using a questionnaire to assess the effects of high tides,

flooding and storm surges to the community of Barangay Taliptip. The study conducted by Sotto determined several flood control measures which were divided into two parts: (1) structural flood control measures and (2) non-structural flood control measures. As for the structural, they considered construction, reconstruction and rehabilitation of watercourses and water protection facilities that would help lessen flood occurrence in the area. While as for the non-structural, the population considers the implementation of physical facilities, trainings, seminars, human resources, linkages and collaboration as the solutions to reduce the flooding in Nabua, Camarines Sur.

According to Palcis (2023), large concrete lego blocks may be considered as the main material in the design and construction of a small-scale flood control barrier. The barrier was formulated in a laboratory and was simultaneously tested in different flooding scenarios. It was then evaluated based on its stability, effectivity and ability to withstand various severity of water flow of flood waters. The results of the study showed that concrete lego blocks were effective as barriers to control the flood of floodwater and prevent further flooding. In addition, it showed excellent resistance to erosion and showed no signs of degradation even after experiencing multiple flooding scenarios.

According to Ybañez, A. A., Aguda, N., Cuyno, K., Jimenez, J. J., Tanpoco, C. M., Antonio, R., and Arcilla, C. (2024) this study evaluated the condition of concrete in three major ports using petrographic analysis alongside standard physical tests. Petrography provided insights into concrete composition, air void distribution, water-

cement ratio, carbonation depth, and the extent of cracking and deterioration. When combined with physical testing, this method offered a more comprehensive understanding of how extreme coastal environments affect port structures. The assessment revealed carbonation in cement paste, along with cracking, alkali-silica reaction, and delayed ettringite formation. Researchers also examined potential causes of degradation, such as material quality, site-specific coastal and climatic conditions, and past extreme weather events like storms and high waves. These findings aim to inform standards and recommendations on concrete cover thickness and mix design, promoting resilient coastal structures capable of withstanding severe environmental stresses.

According to Del Pilar, Eunice, et al. (2024) Coastal areas stand out because of their rich biodiversity and high tourist potential due to their privileged geographical position. However, one of the main problems in these areas is the generation of waste and its management, which must consider technical and sustainable criteria. This work aims to conduct a systematic review of the scientific literature on integrated solid waste management (ISWM) by considering scientific publications on the scientific basis for the proposal of sustainability strategies in the context of use and efficiency. The overall method comprises i) Search strategy, merging and processing of the databases (Scopus and Web of Science); ii) Evolution of coastal zone waste management; iii) Systematic reviews on coastal landfills and ISWM in the context of the circular economy; and iv) Quantitative synthesis in integrated waste management. The results show 282 studies focused on coastal landfills and 59 papers on ISWM with the application of circular

economy criteria. Systematic reviews allowed for the definition of criteria for the selection of favorable sites, such as i) sites far from the coastline, ii) impermeable soils at their base to avoid contamination of aquifers, iii) use of remote sensing and geographic information system tools for continuous monitoring, iv) mitigation of possible contamination of ecosystems, v) planning the possibility of restoration (reforestation) and protection of the environment. In coastal zones, it is necessary to apply the ISWM approach to avoid landfill flooding and protect the marine environment, reducing rubbish and waste on beaches and oceans. Therefore, applying the circular economy in ISWM is critical to sustainability in coastal environments, with the planet's natural processes and variations due to climate change.

Maestro et. al (2023) studied the use of garlic peel extract as an environmentally friendly option to prevent mild steel from corroding in various solutions including acidic (HCl), neutral (NaCl), and basic (NaOH) environments. They wanted to see how these inhibitors performed at different pH levels similar to real-world industrial situations. From electrochemical, mass loss test and microscopic measurements it was found that garlic peel gives good corrosion resistance with maximum inhibitor efficiency at the end of the time of exposure especially in neutral and alkaline solutions. Quantum simulations revealed the active role of allicin and alliin garlic compounds, which produces more protective species in basic condition. These researchers aimed to find an eco-friendly alternative for a locally sourced corrosion inhibitor which has the ability to perform in different corrosive media**.**

Salvati (2024), emphasize understanding of the onset of metal fatigue in metal parts is a very important aspect to be recognized. These are details that also involve the formation of the crack and its growth as a result of repeated metal stress. Corrosion facilitates the enlargement of cracks as well as their propagation. In communities like Barangay Taliptip, which are near the sea, corrosion is a major issue. The researchers want to improve how well metals resist rusting. They also focus on managing waste to cut down on pollutants that speed up corrosion.

FOREIGN LITERATURE:

According to Agborang and Ori (2025), since the floodings tend to increase as time passes by, there are also challenges also arise in terms of the waste management systems. Particularly in Limbe, Cameroon, the authors investigated on the impact of annual floodings on municipal solid waste management systems. Eventhough proper management of solid wastes had already been addressed in various international frameworks, and yet severe flooding still exists, these researchers aimed to develop a more effective waste management system in order to lessen the severity of its impact towards the community. Like Limbe, Barangay Taliptip also experiences similar problem, hence, the researchers also aim to address this by focusing on the design of an effective coastal sea barrier and efficient waste management as well.

Hoagland et al. (2023) conducted a review regarding the advancements in morphodynamic modeling of coastal barrier systems. It had two broad categories namely: (1) event-scale morphodynamics, and (2) long-term morphodynamics. This

literature consists of various models in terms of constructing an effective coastal barrier to address beach and dune erosion, shoreface response, overwash, and breaching. As for the long-term morphodynamics, shoreline change and barrier transgression were taken into consideration. After coming up with several models, it was concluded that they were intuitive, easy to use, and decrease the severity of the impacts of storm water and surges towards the area. Although there were already improvements in terms of the accuracy of simulations, the study is still limited due to the unpredictability of the circumstances.

According to Romão, F., Lima, M., & Coelho, C. (2025) climate change particularly sea level rise and the growing frequency and intensity of storms, has increased the likelihood of overtopping in coastal defense structures, leading to greater shoreline and morphological changes. These impacts present challenges for future managers, engineers, and coastal researchers. A literature review was conducted to examine changes caused by overtopping, wave run-down, and reflux in both natural barriers and coastal defenses. The review aimed to compile and organize scattered information, highlight recurring concepts, and identify areas where research remains limited. It emphasized the links between overtopping, storm events, modeling approaches, and coastal structural changes. Overall, the findings reveal that existing studies are still scarce and often focused only on storm-related effects near defense structures, underscoring the need for further investigation.

According to Franco, Gricelda, et al. (2024) Coastal zones are recognized for their rich biodiversity and high tourism value, yet they face significant challenges in

waste generation and management, which must follow technical and sustainable principles. This study conducted a systematic review of integrated solid waste management (ISWM) in coastal areas, drawing from publications in Scopus and Web of Science to explore sustainability strategies and their efficiency. The review examined the evolution of waste management in coastal zones, landfill practices, ISWM in the framework of the circular economy, and quantitative analyses of waste management systems. Results identified 282 studies on coastal landfills and 59 on ISWM applying circular economy approaches. Key criteria for suitable landfill sites were highlighted, including location away from shorelines, impermeable soil bases, continuous monitoring using GIS and remote sensing, ecosystem protection, and potential for restoration through reforestation. The findings emphasize that ISWM is vital to prevent landfill flooding, safeguard marine ecosystems, and reduce waste in oceans and beaches. Ultimately, integrating circular economy principles into ISWM strengthens sustainability in coastal environments, particularly under the pressures of climate change.

Xu et al. (2023) stated that in steel which supports structures, the comprehension and control of corrosion would thus need a fine understanding of the microscale corrosion mechanism that requires advanced modeling methodologies, including first principles calculations mosaic dynamics, Monte Carlo simulations, cellular automata, finite element methods, and gray correlation analyses. There exist simulations that mimic the process of corrosion going from nano to a macro scale, addressing how compositions of materials, the configurations thereof, and

environmental variables interact to affect the corrosion resistance levels of material. To more precisely forecast corrosion rates and material lifetimes, the researchers stress the application of data mining and big data analytics.

The American Institute of Steel Construction (AISC) the initiation and propagation of cracks due to cyclic tensile loading. Eventually, failure on the structural level may occur when the remaining cross-sectional area cannot withstand the applied loads. Fatigue cracking occurs primarily as a function of loading cycles, which are significantly lower than the static failure limits at the site. The analysis shows that inherent imperfections and discontinuities become most detrimental to fatigue resistance, especially at the welded joints and at regions where stress concentration occurs. Stress range is the most critical concerning fatigue crack propagation since residual welding stresses may exceed the yield strength of the material.

LOCAL LITERATURE:

The Department of Public Works and Highways (DPWH, 2024) established the safety of a community in Casiguran, Aurora by building a seawall structure along its coastline since it is prone to storm surges. DPWH Aurora District Engineering Office (DEO) designed a 346-linear-meter concrete seawall and installed a grouted riprap along the coastline to prevent scouring and erosion caused by strong waves and currents. The said area is being utilized by the local fishermen by anchoring their boats specifically during the times of extreme rainy weathers. Aside from serving as a protection from surges, this project by the DPWH is useful in protecting the livelihood

of the community within the area. The researchers made use of this literature due to its similarity since Barangay Taliptip located in Bulacan also experiences severe flooding not only caused by rainfall but also high tides.

The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), in its 2022 publication, discussed the Rainfall Intensity-Duration-Frequency (RIDF), wherein it produces specialized outputs from analyzed rainfall data. RIDF is considered to be a crucial data for hydrological design since it helps engineers, hydrologist and urban planners in terms of estimating the maximum rainfall that can occur within a certain period of time. These estimates may be used to determine the type of coastal sea barrier that may be constructed in Barangay Taliptip. Figures that would be provided by the RIDF curves are widely used in flood modeling and can be considered as a vital information for infrastructure planning, especially in heavily urbanized and flood-prone areas.

In addition, PAGASA also established an Integrated Hydrological Data Management System (HDMS) for flood forecasters. This system may be used in various river basins nationwide. It produces a reliable and quality-controlled hydrologic data that would be of great help to the flood forecasters in terms of creating an awareness regarding the current status of the flooding nationwide. Also, this would be beneficial to the public as well since they would be informed from time to time with regards to the flooding, its hazards, and various impacts not only to their livelihood but also to their infrastructures, water resources development and land-use planning.

According to Ybanez A. (2023) The Philippines, as an archipelagic nation with a coastline stretching about 18,000 kilometers, relies greatly on maritime industries to support sustainable economic growth. However, this dependence also makes the country highly vulnerable to coastal hazards that could endanger lives and disrupt economic activities. To safeguard communities and sustain maritime operations, the durability of coastal concrete structures—such as seawalls and ports plays a crucial role. This study focuses on evaluating the performance of concrete exposed to extreme weather conditions using standard physical testing methods alongside concrete petrography, which enables microscopic analysis of concrete quality and detection of potential deterioration. A key concern under investigation is the corrosion of steel reinforcement within these structures. Based on the findings, the project intends to recommend suitable concrete cover thicknesses that account for the Philippines' varied microclimates, as well as the anticipated increases in salinity and CO_2 levels in coastal areas in the coming years.

According to Jan Andrew Ensomo, et al. (2023) Climate change has brought significant negative impacts, most notably the increasing intensity of storms. A clear example is Super Typhoon Odette in 2021, which caused severe destruction to lives and infrastructure in Southern Philippines. To mitigate such impacts, seawalls are widely used as protective measures against waves and storm surges in coastal areas. However, many existing designs often fail to provide sufficient protection during extreme tidal events and can even negatively affect local ecosystems. This study focused on developing an improved seawall design in Barangay Cantiasay, Surigao

City, using a descriptive-developmental research approach. An adapted and expert-validated questionnaire was used to assess the design's acceptability, with fifteen civil engineers participating in the evaluation. Results confirmed that the proposed design adheres to the safety and reliability provisions of the National Structural Code of the Philippines (2015), and experts found the design technically sound and acceptable. Overall, the findings demonstrate the feasibility and effectiveness of the upgraded seawall, ensuring greater safety for coastal communities during extreme weather events. The study recommends that the local government of Surigao City consider adopting the proposed design to strengthen community resilience.

Corrosion is the ongoing problem for stainless steel, particularly in aggressive environment like marine and industrial Its corrosion resistance is due to mainly to its chemical composition chromium binds oxygen tightly, creating a thin layer of protection, and other elements like nickel and manganese help improve the metal's hardness. But for very high salinity, acidity and heat conditions, the highest quality of stainless steels like Austenitic 300 series cannot be sustainable According to Baddoo, Mudali and Ma. This will be very relevant in Barangay Taliptip, Bulacan. Constructing infrastructure that lasts the test of time requires knowledge around what contributes to corrosion which is exacerbated by extended exposure to saltwater, moisture and waste runoff, The researchers hope to develop long-term solutions that safeguard the public, enhance waste management, and guarantee infrastructure resilience to environmental disruptions.

According to Teke and Ertas, the performance of engineering components subjected to fatigue is dependent on the geometry of the component. Their extensive and detailed review illustrates how even features of small geometries and design characteristics (e.g., fillets, notches) impact the fatigue life of engineering components. Emerging strategies, such as topology optimization and additive manufacturing, and a more reliability-based design are also introduced to design components that will have improved life-cycle performance against fatigue. This information is extremely relevant to Barangay Taliptip, which is continuously subject to saltwater intrusion, humidity, and mechanical loads. The researchers endeavor to create sustainable and resilient infrastructure allowing for long-term usage of the infrastructure within the context of adverse environmental effects - through the combination of durable materials and geometry optimization - for the locals.

SYNTHESIS OF THE LITERATURE AND STUDIES:

As time passes by, Barangay Taliptip tends to continuously be submerged in the sea water due to the substandard materials used by the contractors for their protection against the water flow. Several factors were considered to contribute significantly to cause the frequent flooding events in Barangay Taliptip such as the gradual increase of establishments in the area, increase of population, and improper construction of barriers which must initially protect the community towards the sea water. With that, these literatures and studies collected would be of great help towards finding out which type of material and approach best suits the project. In order to

reduce sewer overflows and coastal erosion, some researchers (Romei et al., 2021; Perricone et al., 2024) investigated novel approaches such as detention reservoirs and bio-inspired coastal barriers that support biodiversity. On the other hand, there were recent studies that looked at structures and materials for coastal defense, such as rocky revetments (Carlos Coelho et al., 2021), sea water sea sand concrete (SSC), and fiber-reinforced polymer (FRP) bars (Deng et al.).

As for the recent international studies, it collectively highlighted the growing vulnerability of coastal communities to flooding, shoreline change, and structural degradation, as well as the increasing difficulty of managing solid waste in these environments. Agborang and Ori (2025) demonstrate that intensifying annual floods, such as those observed in Limbe, Cameroon, continue to strain municipal waste management systems despite existing global frameworks, emphasizing the need for improved and resilient waste-handling strategies – an issue similarly relevant to Barangay Taliptip.

Overall, this study aims to improve the existing waste management of Barangay Taliptip as well as contribute to the idea of constructing an effective coastal sea barrier for the area. This focuses on what type of material and approach would be the most effective one for this research with the use of the related studies and literatures

CHAPTER III

RESEARCH METHODOLOGY

This chapter focuses on the research methodology and processes used by the researchers to obtain objective results for the design of coastal sea barrier and waste management for Barangay Taliptip, Bulakan, Bulacan. It contains a thorough discussion of the research design, instrument, population, sampling, and data generation procedures, ensuring a favorable positive approach to the study.

RESEARCH DESIGN

This research will be utilized quantitatively to assess and propose an effective coastal sea barrier and waste management along Barangay Taliptip in Bulakan, Bulacan. Since the said area constantly experiences flood events whether due to rainfall or high tides, it tends to affect the daily activities of the community living in Barangay Taliptip which includes the operations of the establishments and businesses, as well as the transportation. Through this research, the researchers will be able to examine the current situation of the waste management of Barangay Taliptip and focus on coming up with ways to solve this recurring problem which is flooding.

Quantitative approach will be used to gather measurable data that could support the design process. The researchers will be using questionnaires in order to collect responses from the involved and affected community in Barangay Taliptip such

as the residents, commuters, and business owners. After gathering their responses, the data would be analyzed using statistical methods to understand their overall experiences, perception of coastal sea barriers, and their eagerness for the construction of a new infrastructure.

By designing an effective coastal sea barrier and waste management for the chosen area, the researchers would not only propose a solution for the recurring problem in Barangay Taliptip but also analyze the overall effects of this problem to the daily living of the community as well. Rest assured that both engineering and social aspects of the problem would be considered as the research goes on.

RESEARCH INSTRUMENT

The researchers would make use of three (3) strategies to gather the necessary data for this study. Firstly, they would construct a survey questionnaire and use this as their primary tool to collect information from the residents, commuters, and business owners in Barangay Taliptip. The questionnaire will consist of several questions pertaining to the personal experiences of the community living and passing by the area. In addition, frequency of flooding in the area, possible causes of flooding, its effects, thoughts on existing waste management, and the proposed coastal sea barrier would also be covered. Before giving out the questionnaire whether personally or through online, it will first be reviewed by the professors who are licensed civil engineering to

ensure that the questionnaire is concise, relevant, and easy to understand by the prospective respondents.

Aside from that, they would also personally visit the area of Barangay Taliptip to assess its overall situation and evaluate whether what particular design of a coastal sea barrier and waste management would be the most suitable and efficient. This strategy would be helpful for the researchers since they would be able to determine the current situation of the area and the severity of exposure of the community to flooding.

Finally, after the site visit and distribution of survey questionnaire, the researchers would make use of an application called AutoCAD for the technical aspects of the study. The use of this application is to draft the design of the coastal sea barrier as well as the waste management. As for the existing design of the waste management, the researchers will be using Google SketchUp to visualize the current design and how it will be improved to make it more effective.

The instruments discussed will enable the researchers to collect the necessary data for this study that will be a crucial part in terms of the proposed design of the coastal sea barrier and improved waste management for Barangay Taliptip in Bulakan, Bulacan.

POPULATION AND SAMPLING TECHNIQUES

The entire study population will be made up of 100 participants, including residents, community leaders and experts. The researchers will conduct simple random sampling**,** a method ensuring that every individual in the population has an equal probability of being selected. This technique is commonly used in statistical studies to ensure an unbiased sample.

DATA COLLECTION PROCEDURE

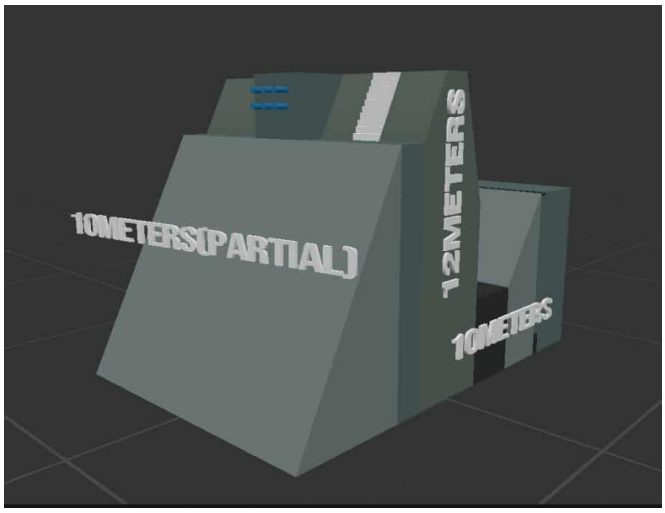
The researchers will first conduct a fieldwork in Barangay Taliptip to assess the current situation of the area. After the fieldwork, they will be conducting a survey through the use of questionnaires in order to gather sufficient data for the assessment of the experiences of the residents, commuters, and business owners in the area. Simultaneously, the researchers would also reach out to the government agencies in Barangay Taliptip to ensure that the information that would be collected is accurate, reliable, and appropriate for the technical and social aspects of the research.

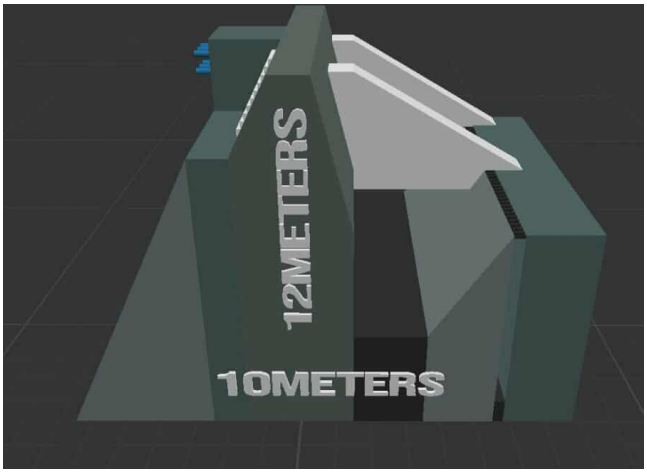
Data would be collected in two ways: (1) the researchers would personally visit Barangay Taliptip and hand out questionnaires to the residents and business owners; and (2) the researchers would also conduct an online survey by finding people who

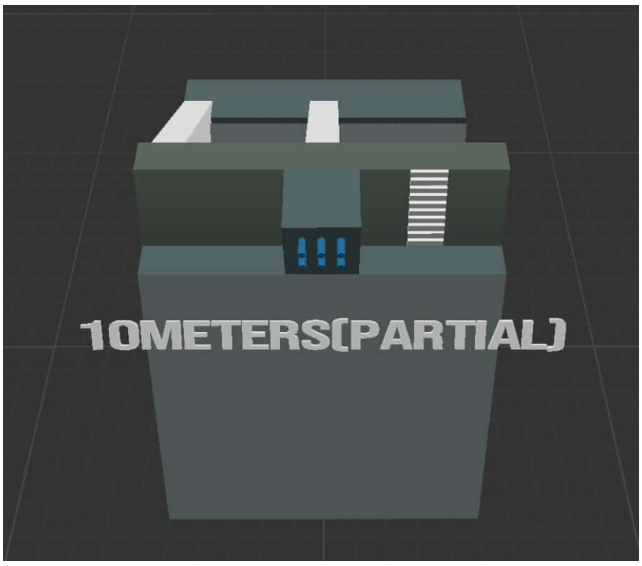
frequently commute and pass by Barangay Taliptip for efficiency. In addition, the researchers will also refer to the official documents and publications from government agencies such as Department of Public Works and Highways (DPWH), and Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) to assess the rainfall intensity data, proposed flood control systems, population statistics, existing waste management system, and other information necessary for the proposed coastal sea barrier and innovation of the current waste management.

All data that would be gathered will be organized and tabulated in order to come up with an effective design of coastal sea barrier and waste management. Through first-hand observation, summary of survey results, and materials and publication from the aforementioned government agencies, it will be ensured that the proposed solution will be based on the current situation of the community and legitimate engineering standards as well.

PROPOSED DESIGN OF DRAINAGE SYSTEM



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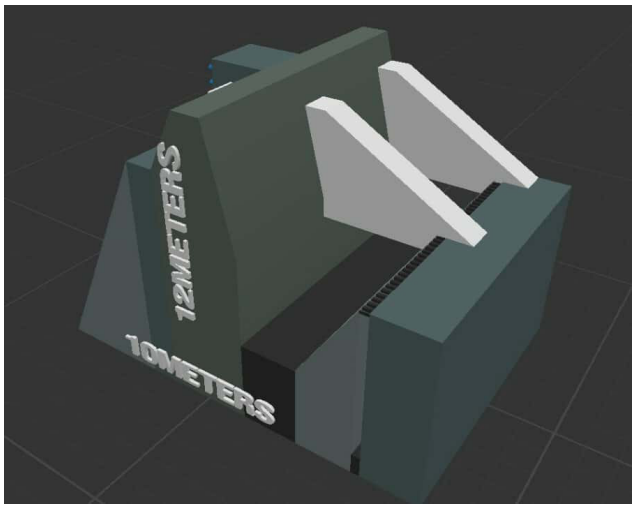
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DATA TREATMENT (STATISTICAL TREATMENT)

This study was designed to gather data from surveys with the residents, community leaders and experts. These tools are important to evaluate the acceptability and effectiveness of this study. The researchers using the following statistical tool that used in this study.

STATISTICAL TREATMENT	**FORMULA**	**APPLICATION OF THE STUDY**
1. Frequency and Percentage Method	$P = (f/n)\ 100$ Where: $p = percentage$ $f = frequency$ $n = total\ number\ of$ *respondents*	To determine the demographic profile. Of the respondents such as age, gender and length area in relation to their awareness of coastal protection and waste management.

2. Weighted Mean	$WM = \frac{\sum fx}{n}$ Where: WM= weighted mean $f = frequency$ $x = weighted\ assigned$ $n = total\ number\ of$ *respondents*	To assess the level of acceptability and effectiveness of the designed coastal sea barrier and waste management system according to community perception.
3. ANOVA (analysis of variance)	$\boldsymbol{F} = \frac{MSB}{MSE}$ Where: MSB= Mean Square Between MSE= Mean Square Error	To compare the perceptions of different groups of respondents (e.g., residents, community leaders, experts) regarding to this proposed project and determine if there are significant differences in their responses.

QUESTIONNAIRE

Title: Design of Coastal Sea Barrier and Waste Management for Barangay Taliptip, Bulakan, Bulacan

Purpose of the Study: This survey aims to collect and compile the opinion of the residents, commuters, and business owners in Barangay Taliptip with regards to the flooding situation in the said area. The researchers also aim to the perspective of the respondents regarding the proposed design of coastal sea barrier and waste management. Reponses that will be gathered would be of great help towards the development of a safer, more efficient, and improved roads for all involved people.

Instructions: Please answer the following questions with all honesty. Rest assured that the responses given will be confidential and will only be used for research purposes.

I. Demographic Information

1. Age Group:
    - Under 18
    - 18 – 32
    - 33 – 47
    - 48 – 60
    - Above 60
2. Gender:
    - Male
    - Female
3. Type of Respondent:
    - Resident of Barangay Taliptip
    - Commuter who often passes by Barangay Taliptip
    - Business Owner in Barangay Taliptip
    - Others (please specify): _____
4. Length of Residency:
    - Less than 1 year
    - 1 year to 3 years
    - 3 years to 5 years
    - More than 5 years
    - Not applicable

II. How does the environment affect the durability of coastal barrier?

5. How would you rate the resistance of the coastal barrier to corrosion (rusting)?
    - Low
    - Moderate
    - High
6. How well do the barriers with stand long-term weathering(sun,wind,rain)?
    - Poorly
    - Adequately
    - Very well
7. How resistant are the barriers to repeated wave impact over time?
    - Not resistant
    - Somewhat resistant
    - Highly resistant

III. How can the design of the barriers be integrated into coastal areas to reduce flooding and solid waste management?

8. How effective is the concrete barrier design in reducing flooding in Barangay Taliptip?
    - Ineffective
    - Moderately effective
    - Highly effective

9. How well do the barriers help reduce the depth of floodwater during storms?
    - Poor control
    - Some control
    - Good control

10. How safe and resilient are the barriers during storms or high tides?
    - Low resilience
    - Moderate resilience
    - High resilience

IV. How can the design of the barriers enhance sustainability and maintain structural integrity and safety?

Instruction: Kindly read carefully and indicate your level of agreement by checking the appropriate box using the scale below.

Scale	Range of Value	Verbal Interpretation
1	4.21 - 5.00	Strongly Agree
2	3.41 - 4.20	Agree
3	2.61 - 3.40	Neutral
4	1.81 - 2.60	Disagree
5	1.0 - 1.80	Strongly Disagree

4.1 Environmental Sustainability	**5**	**4**	**3**	**2**	**1**
1.The barrier design effectively minimizes negative environmental impacts during production and installation.					
2. The materials used in the barrier are environmentally friendly and sustainable.					
3. The design promotes energy efficiency and reduces resource consumption throughout its lifecycle.					
4. The barrier system supports waste reduction and recyclability after its useful life.					
5. The barrier contributes positively to environmental protection and long-term ecological sustainability.					

4.2 Structural Integrity	**5**	**4**	**3**	**2**	**1**
1.The barrier design provides strong structural stability under various environmental conditions.					
2. The materials used in the barrier ensure long-term strength and reliability.					
3. The barrier design effectively resists deformation, cracking or failure under stress.					
4. The structural components of the barrier are well-engineered to withstand loads and external impacts.					
5. The overall design maintains structural integrity with minimal maintenance requirements.					

4.3 Safety and Resilience	**5**	**4**	**3**	**2**	**1**
1.The barrier design ensures the safety of users and surrounding environments.					

2. The barrier can withstand extreme weather or impact conditions without significant damage.					
3. The design includes safety features that reduce the risk of accidents or failures.					
4. The barrier system can recover or maintain function after exposure to adverse conditions.					
5. The overall barrier design promotes long-term safety and resilience with minimal intervention.					

V. **How can the design of the barriers be optimized to be cost effective, sustainable maintenance, safety and functionality?**

5.1 Material Cost Efficiency	**5**	**4**	**3**	**2**	**1**
1. By the use of locally-sourced materials which reduces transportation costs and environmental impact.					
2. By implementing a hybrid design that combines different materials which can optimize cost and performance.					
3. Durability of materials must be prioritized over initial cost savings.					
4. Incorporating nature-based solutions like mangroves, can be more cost-effective than traditional hard infrastructures.					
5. Advanced techniques can minimize material wastes and reduce overall costs in coastal barrier construction.					

5.2 Durability	**5**	**4**	**3**	**2**	**1**
1. Using reinforced concrete or steel in coastal barrier construction ensures long-term durability and resistance to harsh marine environments.					
2. Regular maintenance and inspection are crucial for extending the lifespan of coastal barriers and preventing costly repairs.					
3. Designing coastal barriers with adaptability in mind allows them to withstand future environmental changes and remain durable.					

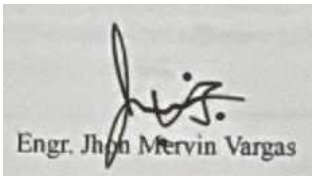
4. Use of innovative materials like fiber-reinforced polymers can enhance the durability and corrosion resistance of coastal barriers.					
5. A well-designed coastal barrier should prioritize resilience to extreme weather events over everyday functionality.					

5.3 Functionality	**5**	**4**	**3**	**2**	**1**
1. A coastal barrier's design should prioritize not only flood protection function but also aesthetic and recreational aspects.					
2. Incorporating gates or sluices in coastal barrier design allows improvement of water flow management and prevents stagnation.					
3. Coastal barriers should be designed to accommodate future urban development and infrastructure needs.					
4. Integrating renewable energy generation, like tidal or wave power, into coastal barrier design can enhance functionality.					
5. Effective coastal barrier design requires a balance between protection from storm surges and preserve natural coastal processes.					

CERTIFICATE OF VALIDATION

This is to certify that the questionnaires on our study entitled, **"DESIGN OF COASTAL SEA BARRIER AND WASTE MANAGEMENT FOR BARANGAY TALIPTIP, BULAKAN, BULACAN"** originally owned by Group B13 with group members: Ritz N. Agnir, Joshua A. Asistente, Paul Wilfred S. Duran, and Melvin D. Rosas, has been assessed and validated on the 23rd day of October 2025.

(NAME OF VALIDATOR AND SIGNATURE)
VALIDATOR



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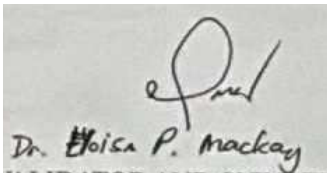

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